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# Estimation of Foreign MNEs spillovers in Spain

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## Abstract

Using Spanish firm-level data, we estimate productivity effects of spillovers from foreign multinationals to domestic firms in both manufacturing and service sectors. We find evidence of a positive productivity effect from multinationals on domestic firms operating in the same industry. Analyzing inter-industry linkages, we find evidence consistent with positive productivity spillovers from forward linkages (i.e., from suppliers to buyers) and negative productivity spillovers from backward linkages (i.e., from buyers to suppliers). Our main results hold when analyzing differences between multinational and domestic firms, and for periods of economic growth and recession, although some differences arise. Interestingly, we find evidence supporting a positive role of spillovers during the last recession period.

*Keywords:* Multinational firms, FDI, spillovers, economic recession.

*JEL codes:* F23, L53, O12.

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## 1. INTRODUCTION

The analysis of spillovers from foreign affiliates to domestic firms has been a topic of considerable interest in the international economics literature in recent decades. One major reason for this interest is their important implications for the design of optimal FDI policies in both developed and developing countries. In fact, according to the most relevant economic growth theories, international technology transfer is considered one of the cornerstones for economic growth (Coe and Helpman, 1995).

However, the effect of foreign MNEs spillovers on local firms' productivity still remains an open question and the empirical evidence on this particular subject is mixed. Interested readers are referred to the empirical literature reviews by Görg and Strobl (2001) and Havranek and Irsova (2012). Theoretical literature also concludes that the relationship between foreign MNEs spillovers and local firms' productivity is unclear. The main theoretical argument that supports the hypothesis of positive spillovers relies on the idea of the public good characteristics of the know-how brought by foreign investors. On the contrary, the presence of MNEs may also result in negative externalities. In this sense, an increase in competition by foreign firms may mitigate horizontal spillovers. Regarding vertical linkages, one possibility for negative spillovers arises because of asymmetries in bargaining power<sup>1</sup>.

This paper develops evidence about spillovers from foreign affiliates to domestic firms using a sample of Spanish firms for the period 2005-2013. Following the related literature, we distinguish between intra-industry spillovers (the so-called horizontal spillovers) and inter-industry spillovers (the so-called vertical spillovers). In this latter case, we further distinguish between downstream (i.e., from buyers to suppliers) and upstream (i.e., from suppliers to buyers) inter-industry spillovers. The contribution of this paper to the empirical literature on foreign MNEs spillovers is three-fold.

First, this issue is of special interest in the Spanish context. The last economic recession has shown that the Spanish economic growth pattern, largely based on the intensive use

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<sup>1</sup>For a more detailed explanation, Girma et al. (2008) summarize the theoretical arguments for both positive and negative effects of foreign MNEs spillovers on domestic firms' productivity.

of factors of production and low productivity levels, is no longer viable. In response to this concern, academics and policy-makers have emphasized the importance of attracting foreign MNEs which operate in high R&D intensity sectors (see, for example, McKinsey-Fedea, 2010). In this context, this paper contributes to this debate by analyzing whether the returns to foreign MNEs spillovers can justify such a policy.

Second, we estimate spillover effects from FDI using both manufacturing and service firms. Although service sectors are becoming increasingly important in terms of FDI inflows in recent years, previous studies refer only to manufacturing firms.

Third, the period analyzed (2005-2013) includes both years of economic expansion and recession. Therefore, our data allow us to test whether spillovers have a different effect depending on the economic cycle.

The rest of the paper is organized as follows. Section 2 introduces the data and describes the empirical approach. Section 3 presents and discusses the estimation results. Finally, Section 4 concludes.

## 2. DATA AND EMPIRICAL SPECIFICATION

### 2.1. Data and measurement of spillovers

The data used in this paper comes from the *Panel de Innovación Tecnológica* (PITEC). PITEC is a firm-level panel data base of Spanish firms based on the Community Innovation Survey (CIS).<sup>2</sup> In this paper, we use data from 2005 to 2013 for the manufacturing and service sectors. After dropping observations with missing values on variables used in the estimation, our final sample consists of an unbalanced panel of 9,393 firms (and a total of 53,123 observations). Around 13% of the observations correspond to foreign MNEs. Fifty-eight percent (58%) of the observations correspond to manufacturing firms whereas 42% correspond to service firms.

Now, we focus on how we measure spillovers from FDI, which are the main interest of

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<sup>2</sup>This survey is being carried out by the INE (The National Statistics Institute) and it is placed at the disposal of researchers on the FECYT web site [https://icono.fecyt.es/PITEC/Paginas/por\\_que.aspx](https://icono.fecyt.es/PITEC/Paginas/por_que.aspx).

our analysis. Later, in Section 2.2, we briefly introduce and define the rest of the variables we use in our estimation. We use widely adopted proxies for spillovers from FDI in the literature (see, among others, Javorcik, 2004, and Blalock and Gertler, 2008). In particular, we use a proxy for horizontal spillovers (i.e., intra-industry spillovers) and two proxies for vertical spillovers (i.e., downstream and upstream inter-industry spillovers). Here, we follow the notation used by Javorcik (2004).

First, horizontal spillovers from multinationals to domestic firms are defined as the share of the total output of an industry that is produced by foreign firms.<sup>3</sup> Hence, our measure of horizontal spillovers ( $HS_{jt}$ ) varies by industry ( $j$ ) and time ( $t$ ).

$$HS_{jt} = \frac{\sum_{i \forall i \in j} Foreignshare_{it} * Y_{it}}{\sum_{i \forall i \in j} Y_{it}} \quad (1)$$

where  $Y_{it}$  is the production of firm  $i$  at time  $t$ , and  $Foreignshare_{it}$  is a proxy of the share of the firm's equity owned by foreign firms.<sup>4</sup>

Our second variable of spillovers measures the foreign presence in the industries supplied by industry  $j$  at time  $t$ . This kind of vertical spillovers occurs through backward linkages (i.e., from buyers to suppliers). Again, this measure of backward spillovers from FDI ( $BS_{jt}$ ) varies by industry ( $j$ ) and time ( $t$ ).

$$BS_{jt} = \sum_{k \text{ if } k \neq j} \alpha_{jk} * HS_{kt} \quad (2)$$

where  $\alpha_{jk}$  is the share of industry  $j$ 's production that is sold to industry  $k$  taken from the input-output tables. In practice, we use information from two different input-output tables. Values of  $\alpha_{jk}$  from 2005 to 2009 are from the 2005 input-output table, while values of  $\alpha_{jk}$  from 2010 to 2013 are from the 2010 input-output table.

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<sup>3</sup>We group firms into 30 manufacturing and service industries. The number of different industries available is the result of matching information from PITEC and two input-output tables (see below).

<sup>4</sup>This variable takes a value of 0 for firms with 0 percent of foreign ownership; a value of 0.05 for firms with a foreign ownership greater than 0 percent and lower than 10 percent; a value of 0.35 for firms with a foreign ownership greater than or equal to 10 percent and lower than 50 percent; and a value of 0.75 for firms with a foreign ownership greater than or equal to 50 percent.

Finally, we use a proxy for vertical spillovers through forward linkages (i.e., from suppliers to buyers). This variable of forward spillovers from FDI ( $FS_{jt}$ ) is a measure of the foreign presence in the upstream (or supplying) industries of industry  $j$  at time  $t$ . Following Javorcik (2004), in this case we exclude exports of foreign affiliates ( $X_{it}$ ).<sup>5</sup> Therefore, variable  $FS_{jt}$  is defined as:

$$FS_{jt} = \sum_{m \text{ if } m \neq j} \sigma_{jm} \left[ \frac{\left[ \sum_{i \forall i \in m} Foreignshare_{it} * (Y_{it} - X_{it}) \right]}{\sum_{i \forall i \in m} (Y_{it} - X_{it})} \right] \quad (3)$$

where  $\sigma_{jm}$  is the share of industry  $j$ 's inputs that is purchased from industry  $m$  taken from the input-output tables. Again, we use information from the 2005 and 2010 input-output tables.

## 2.2. Empirical model

Following the related literature, we consider an augmented production-function framework that includes the spillovers variables described above. Starting from a log specification of a Cobb-Douglas production function, the final expression to be estimated is:

$$y_{it} = \alpha_0 + \alpha_1 k_{it} + \alpha_2 l_{it} + \alpha_3 MNE_{it} + \alpha_4 HS_{jt} + \alpha_5 BS_{jt} + \alpha_6 FS_{jt} + \alpha_7 recession_t + controls + \eta_{it} + \varepsilon_{it} \quad (4)$$

where  $y_{it}$  is the log of the output of firm  $i$  in year  $t$ , and  $k_{it}$  and  $l_{it}$  represent the logs of capital and labor, respectively.<sup>6</sup> Besides the effects of traditional inputs ( $k$ , and  $l$ ) on production, Expression (4) offers a useful basis for measuring the impact of spillovers on firm productivity. Variable  $MNE_{it}$  is a foreign ownership dummy indicating whether the

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<sup>5</sup>As pointed out by Javorcik (2004), this is done to consider only the production sold in the domestic market.

<sup>6</sup>Physical capital is constructed for each firm by cumulating the physical investments using the perpetual inventory method. Output and physical investments are deflated to express values in real terms. The deflators are based on the industrial price index and the service sector price index provided by the INE. We use the GDP deflator when industry-level prices are not available.

firm's equity owned by foreign investors is equal to at least 50 percent. An interesting feature of our data is that it covers a period of economic growth and recession. To take this into account, we include a dummy variable ( $recession_t$ ) for years of recession (period 2008-2013). In our estimation, we also control for the firm's age, and year, industry and regional dummies.<sup>7</sup> Finally,  $\eta_{it}$  is a productivity shock, and  $\varepsilon_{it}$  is an uncorrelated zero mean error term.

In addition to the basic specification in Expression (4), we also include interaction terms to test whether spillovers have a different effect for multinational and domestic firms, and for periods of economic growth and recession.

To estimate Expression (4), we use the estimator proposed by Olley and Pakes (1996).<sup>8</sup> This method deals with both the simultaneity problem and the selection problem due to endogenous exit. As proposed by these authors, we treat age of the firm and capital as state variables, labor as freely variable input, and physical investments of the firm as the proxy variable.

### 3. RESULTS

Table 1 presents the results for the estimation of Expression (4). Estimated elasticities for traditional inputs (capital and labor) show plausible values. We find that multinationals are more productive, which may reflect that foreign firms may be investing in the most productive domestic firms. Moreover, as expected, the recession dummy shows a negative coefficient, indicating the existence of a procyclical productivity effect. Regarding our main variables of interest, we find evidence supporting the existence of a positive productivity effect of horizontal and forward spillovers, although this latter effect is small in magnitude.

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<sup>7</sup>Following Huergo and Jaumandreu (2004), when age is older than 40 years, we change it to a unique category of 40 or more years. We group firms by industry into six categories: high-tech manufacturing firms; medium-high tech manufacturing firms; medium-low tech manufacturing firms; low-tech manufacturing firms; knowledge-intensive services; and non-knowledge-intensive services. Finally, we consider four Spanish regions: Madrid; Cataluña; Andalucía; and the rest of Spain.

<sup>8</sup>We use the Olley-Pakes estimation package for Stata; see Yasar et al. (2008).

On the contrary, backward spillovers seem to have a negative effect on productivity. This result is in line with other empirical findings. For example, Liu (2008) finds a negative short-run effect of backward spillovers for Chinese firms.

Comparing our results to other studies in Spain, Barrios and Strobl (2002) also find a positive effect of horizontal spillovers, although this effect is only significant for exporting firms. However, these authors do not find any significant effect of inter-industry spillovers. On the other hand, Jabbour and Mucchielli (2007) find a variety of results depending on different characteristics of foreign affiliates and domestic firms. In relation to our results, these authors find that backward linkages with partially-owned affiliates have a negative effect on the productivity of domestic firms.

Table 2 shows the results for the specification of Expression (4) with interaction terms. Column (1) in Table 2 presents the results including the interaction of spillovers variables with the multinational dummy, while Column (2) in Table 2 focuses on the interactions with the recession dummy variable. The main pattern of results holds for multinationals and domestic firms, and during recession and expansion periods. However, some interesting differences arise. First, horizontal spillovers are higher for domestic firms than for multinationals, while the opposite happens for forward spillovers. In addition, the negative effect of backward spillovers is much higher in magnitude for multinationals than for domestic firms. Second, spillovers variables show a positive interaction effect with the recession dummy. We find evidence supporting that horizontal and forward spillovers are higher in magnitude during recession years. Moreover, the effect of backward spillovers, although still negative, is lower in magnitude during recession years. These results suggest the existence of an anticyclical productivity effect of spillovers, emphasizing the role of spillovers during the last recession period.

#### 4. CONCLUSIONS

In this paper, we estimate the productivity effects of foreign multinationals spillovers using a panel of Spanish manufacturing and service firms for the period 2005-2013. To do



this, we estimate an augmented Cobb-Douglas production function that includes variables that measure horizontal and vertical spillovers from MNEs. In practice, horizontal spillovers refer to the linkages from multinationals to domestic firms within the same industry, while vertical spillovers measure the extent of inter-industry backward and forward linkages.

First, our results show that intra-industry spillovers from foreign multinationals have a positive effect on domestic firms' productivity. Second, regarding inter-industry spillovers, we find evidence consistent with positive productivity spillovers from forward linkages (i.e., from suppliers to buyers) and negative productivity spillovers from backward linkages (i.e., from buyers to suppliers). Third, our main results hold when analyzing differences between multinational and domestic firms, and for periods of economic growth and recession. However, some interesting differences arise. An interesting finding is that, during recession years, the positive effect of both horizontal and forward spillovers is higher in magnitude, while the negative effect of backward spillovers is lower in magnitude. These results emphasize the role of spillovers during the last recession period.

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Table 1. Baseline results (OP)

(1) OP		
Variable	Coefficient	SD
Age	0.008	[0.006]
Physical capital	0.262***	[0.032]
Labor	0.782***	[0.009]
MNE	0.337***	[0.025]
Recession	-0.119***	[0.020]
HS	1.911***	[0.092]
BS	-1.183***	[0.123]
FS	0.466***	[0.047]

Estimates include year, industry and regional dummies but they are not reported.

Standard errors in OP model are bootstrapped using 100 replications. \*\*\*significant at 1%

Table 2. Interaction effects of spillovers with multinationals and recession

Variable	(1) OP		(2) OP	
	Coefficient	SD	Coefficient	SD
Multinational	0.652***	[0.074]	0.336***	[0.032]
Recession	-0.116***	[0.018]	-0.356***	[0.023]
HS	2.042***	[0.094]	1.833***	[0.104]
BS	-0.953***	[0.139]	-1.937***	[0.183]
FS	0.414***	[0.048]	0.429***	[0.021]
MNE*HS	-0.561***	[0.155]		
MNE*BS	-1.870***	[0.374]		
MNE*FS	0.675***	[0.174]		
Recession*HS			0.178***	[0.049]
Recession*BS			1.214***	[0.143]
Recession*FS			0.051*	[0.027]

Estimated coefficient of age and of traditional inputs (capital and labor) are not reported. Estimates include year, industry and regional dummies, but they are not reported. Standard errors in OP model are bootstrapped using 100 replications.

\*\*\*significant at 1%, \* significant at 10%